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Transmitted herewith for filing in the above-identified application are the following enclosures:

(X) English translation of U.S. Provisional Application No. 60/459,946 filed April 2, 2003 in 22 pages.

(X) Verification of Translation.

(X) Return prepaid postcard.

(X) Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

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VERIFICATION OF TRANSLATION

I, undersigned below, hereby declare that:

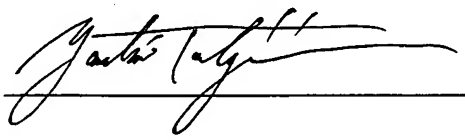
My name and post office address are as stated below:

That I am knowledgeable in the English language and in the language in which the below identified U.S. Provisional Application was filed, and that I believe the attached English translation of the U.S. Provisional Application No. 60/459,946 filed on April 2, 2003 is a true and complete translation of the above-identified Provisional Application as filed.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 10 / 8 / 2004

Full Name of the Translator: Yasuhiro Tochigi

Signature of the translator: 

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[Document Name] Specification

[Title of the Invention] POWER TRANSMISSION DEVICE OF ENGINE FOR ALL TERRAIN VEHICLE

[Claims]

[Claim 1] A power transmission device of an engine for an all terrain vehicle for transmitting rotation of its crankshaft to an output shaft through a V-belt type continuously variable transmission, said vehicle having rough ground-running wheels mounted at the front and the rear of a body frame on both left and right sides and a seat mounted approximately in the longitudinal middle of the body frame, wherein said engine is mounted such that at least part of the engine is located under the seat; a cooling air suction duct connected to a transmission case for housing said V-belt type continuously variable transmission is opened at a higher place than the seat surface of said seat; and a cooling air delivery duct is opened near the seat surface of said seat.

[Claim 2] The power transmission device of an engine for an all terrain vehicle according to Claim 1, wherein said seat is divided into left and right seats; said cooling air suction duct opens at a position behind the rear surfaces of seat backs of said left and right seats so as to face the front of the vehicle; said cooling air delivery duct opens between the seat surfaces of said left and right seats toward the rear of the vehicle; and at least part of the cooling air delivery duct is hidden under the seat surface of said seat when viewed in plan.

[Claim 3] The power transmission device of an engine for the all terrain vehicle according to Claim 2, wherein the portion of said cooling air delivery duct located under the seat has a sectional shape following the contour of the bottom of said seat.

[Detailed Description of the Invention]

[Field of the Invention]

This invention relates to a power transmission device of an engine for an all terrain vehicle for transmitting the rotation of a crankshaft to an output shaft through a V-belt type continuously variable transmission.

[Prior Art]

In some all terrain vehicles of this kind, wheels with balloon tires are disposed at the front and the rear of the body frame on the left and right sides, a seat for two riders in the middle, and an engine unit with a V-belt type continuously variable transmission is mounted under the seat. In this case, from the view point of suppressing deterioration of the V-belt due to frictional heat, cooling air is introduced into the transmission case to cool the V-belt.

Regarding the foregoing all terrain vehicles, it is presumed from their applications that in some cases the vehicle runs, with its wheels nearly submerged in the water. Therefore, a system has been suggested in which the cooling air suction port of the transmission case is formed at a high place of the body frame lest water should be taken in during running in the water (For example, see Patent Document 1).

[Patent Document 1]

USP No.5086858

[Problems to be Solved by the Invention]

However, since in the foregoing conventional device, only the cooling air suction port is located at a high place, if engine is stopped while the cooling air delivery port is submerged in the water, water may enter the belt chamber so that running is impossible even if the engine is restarted.

In view of the foregoing, an object of this invention is to provide a power transmission device of an engine for an all terrain vehicle capable of preventing ingress of water in a transmission case reliably and effecting a satisfactory

running at the time of restarting.

[Means for Solving the Problems]

The invention of Claim1 is characterized by a power transmission device of an engine for an all terrain vehicle for transmitting rotation of its crankshaft to an output shaft through a V-belt type continuously variable transmission, said vehicle having rough ground-running wheels mounted at the front and the rear of the body frame on both left and right sides and a seat mounted approximately in the longitudinal middle of the body frame, wherein said engine is mounted such that at least part of the engine is located under the seat; a cooling air suction duct connected to a transmission case for housing said V-belt type continuously variable transmission is opened at a higher place than the seat surface of said seat; and a cooling air delivery duct is opened near the seat surface of said seat.

The invention of Claim 2 is characterized by the power transmission device according to Claim 1, wherein said seat is divided into left and right seats; said cooling air suction duct opens at a position behind the rear surfaces of seat backs of said left and right seats so as to face the front of the vehicle; said cooling air delivery duct opens between the seat surfaces of said left and right seats toward the rear of the vehicle; and at least part of the cooling air delivery duct is hidden under the seat surface of said seat when viewed in plan.

The invention of Claim 3 is characterized by the power transmission device according to Claim 2, wherein the portion of said cooling air delivery duct located under the seat has a sectional shape following the contour of the bottom of said seat.

[Function and Effect of the Invention]

In the power transmission device according to the invention of Claim 1, a cooling air suction duct of the transmission

case is opened at a higher place than the seat surface of the seat and a cooling air delivery duct is opened near the seat surface of the seat. Therefore, a cooling air suction port and a cooling air delivery port can be located at higher places than wheels, so that ingress of water into the belt chamber can be prevented even when the vehicle runs in the water, with its wheels submerged, providing reliable running at the time of restarting of the engine.

In the invention of Claim 2, since the cooling air suction duct is opened at a place behind the rear surfaces of the seat backs toward the front, a running wind at relatively low temperature can be taken in to the belt chamber and the V-belt can be cooled efficiently, suppressing deterioration due to frictional heat. Also, since the cooling air delivery duct is opened between the seat surfaces of the seats toward the rear, offensive noise in the belt chamber to the rider's ear can be suppressed.

At least part of the cooling air delivery duct is disposed under the seat, so that the delivery duct can be hidden by the seat, preventing worsening of its appearance.

In the invention of Claim 3, since the portion of the cooling air delivery duct located under the seat has a sectional shape following the contour of the bottom of the seat, the delivery duct can be disposed compact and with good appearance.

[Embodiment of the Invention]

Now, an embodiment of this invention is described with reference to the accompanying drawings.

Figs. 1 to 7 illustrate a power transmission device of an engine for an all terrain vehicle according to an embodiment of this invention; Figs. 1 and 2 are a side and a plan view of an all terrain vehicle, respectively; Figs. 3 and 4 are side views of an engine unit with a V-belt type continuously variable transmission; Fig. 5 is a plan view of the engine

unit; and Figs 6 and 7 are a plan and a rear view of an air delivery duct, respectively. The term "right and left, or front and rear" used herein means the right and left, or the front and rear when viewed by a rider sitting on the seat.

In the figures, numeral 1 designates an all terrain vehicle, arranged such that front wheels 3 and rear wheels 4 fitted with rough ground-running balloon tires, are disposed at the forward and the rearward ends of the body frame 2 on the left and right sides, respectively, a laterally split type seat 5 for two riders in the longitudinal middle of the body frame 2, and an engine unit 6 is mounted under the seat 5.

On the body frame 2 are disposed a driving device 11 for distributing power of the engine unit 6 to front and rear drive shafts 7, 8 to transmit the power from the front and rear drive shafts 7, 8 to left and right, front and rear wheels 3, 4 through front and rear differential gear units; a steering device 13 for transmitting the rotation of a steering wheel 12 disposed in front of the seat 5 to the left and right front wheels 3 through a steering shaft 55; and front and rear suspension devices 14, 15 for supporting independently the left and right front wheels 3 and left and right rear wheels 4 for up and down swinging movement, respectively.

At the front of the body frame 2 is disposed a hood 16 covering openably the left and right front wheels from above and behind the seat 5 is disposed a carrier 17.

The steering shaft 55 can be adjusted in its tilt angle upwardly toward the rear by a ratchet type tilt mechanism (not shown). This allows the height of the steering wheel 12 to be set to any specified value according to the rider's height.

The body frame 2 comprises a main frame 20 made up of left and right side members 18, 18, and cross members 19 connecting the side members at their front, rear and central portions; a front frame 21 disposed upright at the front of the main frame 20; a rear frame 22 disposed upright at the rear; and left and

right pillar frames 24, 24 disposed between the front frame 21 and rear frame 22 of the main frame 20 and constituting a cabin, together with the main frame 20.

A floor panel 23 is disposed between the front frame 21 and rear frame 22 of the main frame 20, extending between the left and right pillar frames 24, 24.

Arm rests 65 are attached to the pillar frames 24 at the respective left and right sides for pivotal movement, as shown in Figs. 4 and 5. The arm rest 65 serves as a means of supporting the rider's elbow and can be rotated between a storing position along the side surface of each of the seat backs 30b, 31b and a working position in which it extends forwardly in the approximately horizontal direction. In addition, each of the left and right seats 30, 31 is provided with a three-point seat belt (not shown) for holding the rider in the seat, which maintains rider's driving posture at the time of sports-running on the rough ground. A metal fitting (not shown) for supporting the seat belt is attached to the pillar frame 24 at the inner side for the prevention of, for example, being caught on branches during running in the wood.

A front bumper 27 is provided at the forward end of the body frame 2. A radiator 28 is disposed inside a hood 16 between the front bumper 27 and front frame 21, and a battery 29 behind the radiator 28. The battery 29 is disposed fixedly on the front frame 21 above the front differential gear unit 9.

Since the battery 29 is disposed behind the radiator 28, the weight balance of the vehicle can be set to be near the front wheel, compared with, for example, when it is disposed near the engine under the seat, resulting in a more proper weight distribution. In addition, the battery 29 can be cooled by a cooling fan 28a of the radiator 28, thereby suppressing temperature rise of the battery. Further, the battery 29 is disposed inside the hood 16 above the front differential gear unit 9, thereby preventing the battery 29 from being submerged

during running. Furthermore, since the battery 29 is disposed on the front frame 21, a vacant space can be formed under the seat, compared with when it is disposed under the seat, enabling large-sized objects such as a fuel tank, luggage box and the like to be disposed under the seat 5 by utilizing the space.

The seat 5 is divided into left and right seats 30, 31, and the left and right seats 30, 31 are disposed at the upper forward end of the rear frame 21 with a given clearance in the lateral direction. The left and right seats 30, 31 are arranged such that seat backs 30b, 31b are formed integral with detachable seat cushions 30a, 31a. The steering wheel 12 is disposed in front of the left seat 30, and a shift lever 42 in front of the left and right seats 30, 31 therebetween. The shift lever 42 serves as a means for switching any of parking, advancing of H-N-L and reversing positions.

The engine unit 6 comprises a water-cooled, four-stroke and single-cylinder engine body 35 and a V-belt type continuously variable transmission 36 as a power transmission device joined together. The V-belt type continuously variable transmission 36 is disposed on the left side of the engine body 35 in the lateral direction.

The engine body 35 is arranged such that a cylinder block 35b and a cylinder head 35c are connected to a crankcase 35a for housing a crankshaft 37 disposed horizontally in the lateral direction, and a head cover 35d is mounted on the cylinder head 35c. An intake port 35f opens at the front wall 35e of the cylinder head 35c, and an exhaust port 35h at the rear wall 35g.

A transmission case 38 is connected to the left wall of the crankcase 35a, and the V-belt type continuously variable transmission 36 is housed in a belt chamber of the transmission case 38. The continuously variable transmission 36 has a structure in which a V-belt 36c is installed around a

drive pulley 36a mounted on the crankshaft 37 and a follower pulley 36b mounted on an output shaft 39 parallel to the crankshaft 37. Engine output from the output shaft 39 is transmitted to the front and rear drive shafts 7, 8 through a bevel gear mechanism 40.

The power transmission device is provided with a belt chamber cooling mechanism for introducing cooling air into the belt chamber of the transmission case 38, the structure of which is described in the following.

The rear and the front wall of the transmission case 38 are formed, with a cooling air suction port 38a and a cooling air delivery port 38b in communication with the belt chamber, respectively. To the cooling air suction port 38a is connected a lower end opening 67a of a cooling air suction duct 67 extending vertically. The cooling air suction duct 67 is disposed between the left and right seats 30, 31 and behind the seat backs 30b, 31b. An upper end opening 67b of the suction duct 67 is located at a higher place than the seat surfaces of the seat cushions 30a, 31a and opens toward the front of the vehicle. Here, as shown in Fig. 4 by double dot and dash lines, a cooling air suction duct 67' may be elongated up to the upper edge of the seat back 30b and an upper end opening 67b' may be opened toward the rear of the vehicle. In that case, thermal influence by the engine can be prevented more reliably.

To the cooling air delivery port 38b is connected an upstream opening 68a of a cooling air delivery duct 68. The cooling air delivery duct 68 has a vertical duct portion 68c rising upwardly from the upstream opening 68a and a horizontal duct portion 68d extending, under the left seat cushion 30a, rearwardly from the upper end of the vertical duct portion 68c generally in the horizontal direction, and a downstream opening 68b of the horizontal duct portion 68d at the rear end opens toward the rear of the vehicle at the lower rear portion

of the seat cushion 30.

The horizontal duct portion 68d is disposed along the inner edge of the seat cushion 30a in plan in nearly hidden relation. The horizontal duct portion 68d is formed in a triangular shape in section following the contour of the bottom wall 30c of the seat cushion 30a.

In the power transmission device of this embodiment, the cooling air suction duct 67 is connected to the cooling air suction port 38a formed in the rear wall portion of the transmission case 38, the upper end opening 67b of the suction duct 67 is opened at a higher place than the seat surface of the seat cushion 30a, the cooling air delivery duct 68 is connected to the cooling air delivery port 38b formed in the front wall portion, and the downstream opening 68b of the delivery duct 68 is opened at the lower rear portion of the seat cushion 30a. Therefore, the upper end opening 67b through which cooling air is sucked in and the downstream opening 68b through which cooling air is discharged, can be located at a higher place than the front and rear wheels 3, 4. As a result, even if the vehicle runs in the water, with its front and rear wheels 3, 4 nearly submerged, ingress of water into the belt chamber is prevented, ensuring running when the engine is restarted.

In this embodiment, the cooling air suction duct 67 is disposed between the left and right seats 30, 31 and behind the seat back 30b, with its upper end opening 67b opened toward the front of the vehicle. Therefore, a running wind at low temperature can be taken into the belt chamber and the V-belt 36c can be cooled efficiently, suppressing its deterioration due to frictional heat.

In addition, the horizontal duct portion 68d of the cooling air delivery duct 68 is opened at the lower rear portion of the seat cushion 30a toward the rear. Therefore, offensive noise generated in the belt chamber is released rearwardly of

the rider, suppressing noise effect to the rider.

Further, since the horizontal duct portion 68d of the cooling air delivery duct 68 is disposed under the seat cushion 30a, it can be hidden by the seat cushion 30a, preventing worsening of the appearance.

In this embodiment, since the horizontal duct portion 68d is formed in a triangular shape in section following the contour of the bottom 30c of the seat cushion 30a, the cooling air delivery duct 68 can be disposed compactly with a good appearance.

The engine unit 6 is mounted on the rear frame 22 such that the output shaft 39 is located forwardly of the crankshaft 37, and the crankshaft 37 and output shaft 39 are located under the seat 5 and laterally centrally of the vehicle between the left and right seats 30, 31.

The cylinder block 35b and cylinder head 35c of the engine body 35, when viewed from the left side, are in part protruded reawardly from the lower rear ends of the seat backs 30b, 31b of the left and right seats 30, 31, and their cylinder axis A rises obliquely upwardly, for example, at 45 degrees.

Since the engine unit 6 is mounted such that the output shaft 39 and crankshaft 37 are located under the seat 5 and the output shaft 39 is located forwardly of the crankshaft 37, the engine unit 6 can be mounted, with the cylinder head 35c directed rearwardly, and the amount of rearward protrusion of the engine unit 6 can be decreased without interference with the seat 5 or rider's legs. As a result, the wheel base can be reduced, providing size reduction of the vehicle body.

In addition, since the engine unit 6 is mounted, with the cylinder head 35c directed rearwardly of the vehicle, influence of the engine heat on the rider can be suppressed, enabling walking-through on the left and right seats 30, 31.

In this embodiment, since the cylinder block 35b and cylinder head 35c of the engine body 35 are in part protruded

rearwardly from the lower rear ends of the seat backs 30b, 31b and raised obliquely upwardly, the cylinder block 35b and cylinder head 35c at high temperature can be kept away from the rider, thereby preventing influence on the rider by the engine heat.

To the front wall 35e of the cylinder head 35c is connected an intake device 45 extending forwardly, and to the rear wall 35g an exhaust device 46 extending rearwardly.

The exhaust device 46 is arranged such that a pair of exhaust pipes 47, 47 are connected, so as to be in communication with an exhaust port 35h, to the rear wall 35g, and a muffler 48 is connected to the downstream ends of the exhaust pipes 47. The exhaust pipe 47 is formed into a wave-like shape bent up and down in profile, and the muffler 48 is disposed behind the body frame 2 in the lateral direction.

Here, as shown in Figs. 8 and 9, the muffler 48 may be disposed behind the engine unit 6 in the lateral direction and in front of the axle of the rear wheel 4. If the muffler 48 is disposed closely behind the engine unit 6 within the wheel base, as described above, the moment of inertia in the yawing direction can be kept in check, suppressing influence on the driveability. That is, if a heavy object such as a muffler is disposed at a distance from the center of gravity of the vehicle, the moment of inertia in the yawing direction is apt to be increased, which may affect the driveability.

Now, the intake device 45 is described. The intake device 45 is arranged such that the downstream opening of a throttle body 50 is connected so as to be in communication with the intake port 35f, to the front wall 35e through an intake pipe 49, the downstream end of an intake air duct 51 is connected to the upstream opening of the throttle body 50 through an accumulator 53, and an air cleaner 52 is connected to the upstream end of the intake air duct 51.

In the throttle body 50 is accommodated a throttle valve 50a for variably controlling the sectional area of the intake passage. Also, to the throttle valve 50 is connected an accelerator pedal disposed forward of the left seat 30.

The air cleaner 52 is disposed between the left and right front wheels 3 and inside and near the hood 16 above the front wheels 3, and mounted to the front frame 21. The air cleaner 52 is disposed, being inclined downwardly toward the front, along the hood 16, to the rear end face 52 of which is connected an intake air duct 51.

The intake air duct 51 has a slanting portion 51d connected to the rear end face 52a of the air cleaner 52 and extending obliquely upwardly toward the rear so as to be located at a higher place than the air cleaner 52; a vertical portion 51a extending downwardly generally in the vertical direction from the upper end of the slanting portion 51d; a horizontal portion 51b extending from the lower end of the vertical portion 51a to a place near the front of the seat 5 along the lower side of the floor panel 23; and a rising portion 51c extending from the rear end of the horizontal portion 51b upwardly generally in the vertical direction along the front of the rear frame 22.

The portion of the intake air duct 51 from the rising portion 51c to the upstream opening of the throttle body 50 constitutes the accumulator 53 having a sectional area larger than that of the intake air duct 51.

In the intake device 45 of this embodiment, since the air cleaner 52 is disposed between the left and right front wheels 3 and inside and near the hood 16 covering the front wheels from above, the air cleaner 52 can be kept away from the engine unit 6, suppressing intake air temperature rise due to heat from the engine and preventing a bad influence on the engine performance such as a drop in charging efficiency due to intake air temperature rise.

In addition, the air cleaner 52 is located upwardly of the front wheels 3, so that no water is sucked in even if the vehicle runs in the water, with the front wheels 3 nearly submerged, preventing ingress of water into the engine.

In this embodiment, since the intake air duct 51 is made up of the vertical portion 51a extending downwardly from the air cleaner 52; a horizontal portion 51b extending from the vertical portion 51a to the seat 5 along the lower side of the floor panel 23; and a rising portion 51c extending from the horizontal portion 51b, the intake air duct 51 can be laid at a position distant from the engine unit 6, suppressing intake air temperature rise due to heat from the engine.

In addition, the portion of the intake air duct 51 from the rising portion 51c to the throttle body 50 can be used as an accumulator capacity, thereby securing the responsive property to the intake air. Although the accumulator 53 is located near the engine body 35, influence due to engine heat is not very large because the heat capacity of the accumulator 53 is smaller than that of the air cleaner 52.

In this embodiment, since the slanting portion 51d of the intake air duct 51 connected to the air cleaner 52 is located at a higher place than the air cleaner 52, preventing ingress of water into the engine even if water enters inside the air cleaner 52.

[Brief Description of the Drawings]

Fig. 1 is a side view of an all terrain vehicle, illustrating a power transmission device according to an embodiment of this invention;

Fig. 2 is a plan view of the all terrain vehicle;

Fig. 3 is a side view of an engine unit mounted on the all terrain vehicle;

Fig. 4 is a side view of the engine unit;

Fig. 5 is a plan view of the engine unit;

Fig. 6 is a plan view of a cooling air delivery duct of the

engine unit;

Fig. 7 is a rear view of the cooling air delivery duct;

Fig. 8 is a plan view, showing another example of muffler placement of this embodiment; and

Fig. 9 is a side view of the muffler placement.

[Description of Reference Numerals]

1: all terrain vehicle 2: body frame 3: front wheel

4: rear wheel 5: seat 6: engine unit 30: left seat

31: right seat 35: engine body

36: V-belt type continuously variable transmission 37: crankshaft

38: transmission case 39: output shaft

67: cooling air suction duct 68: cooling air delivery duct

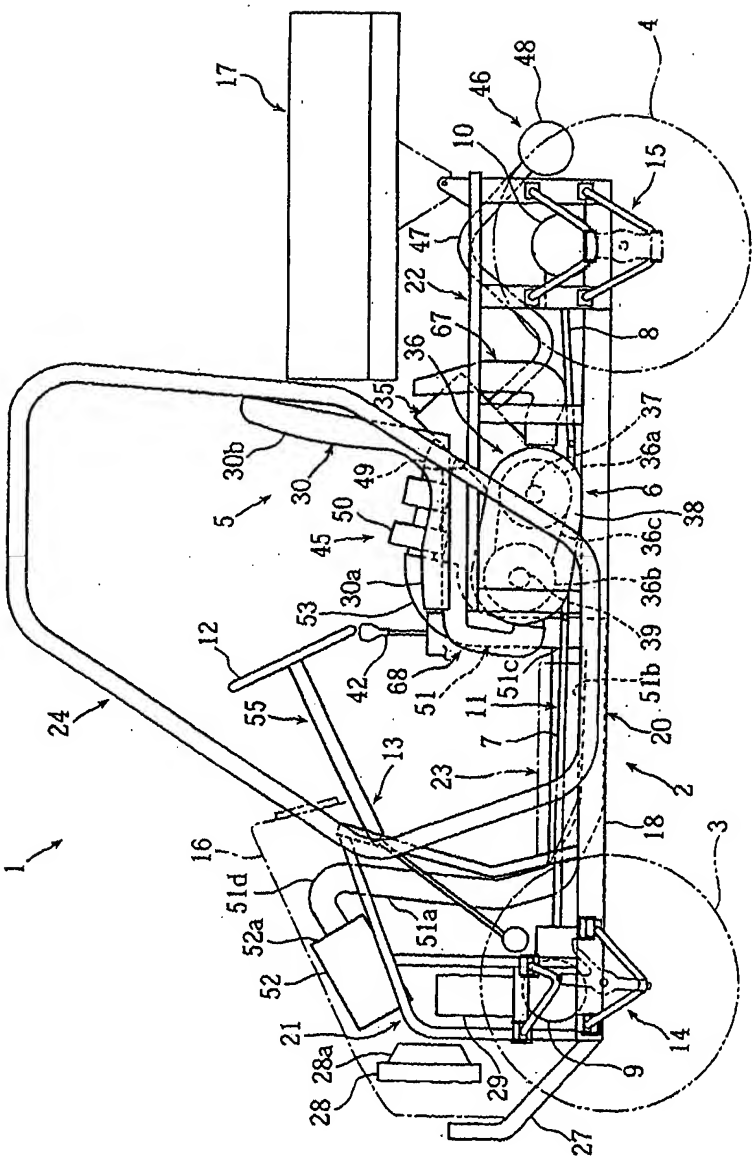


FIG. 1

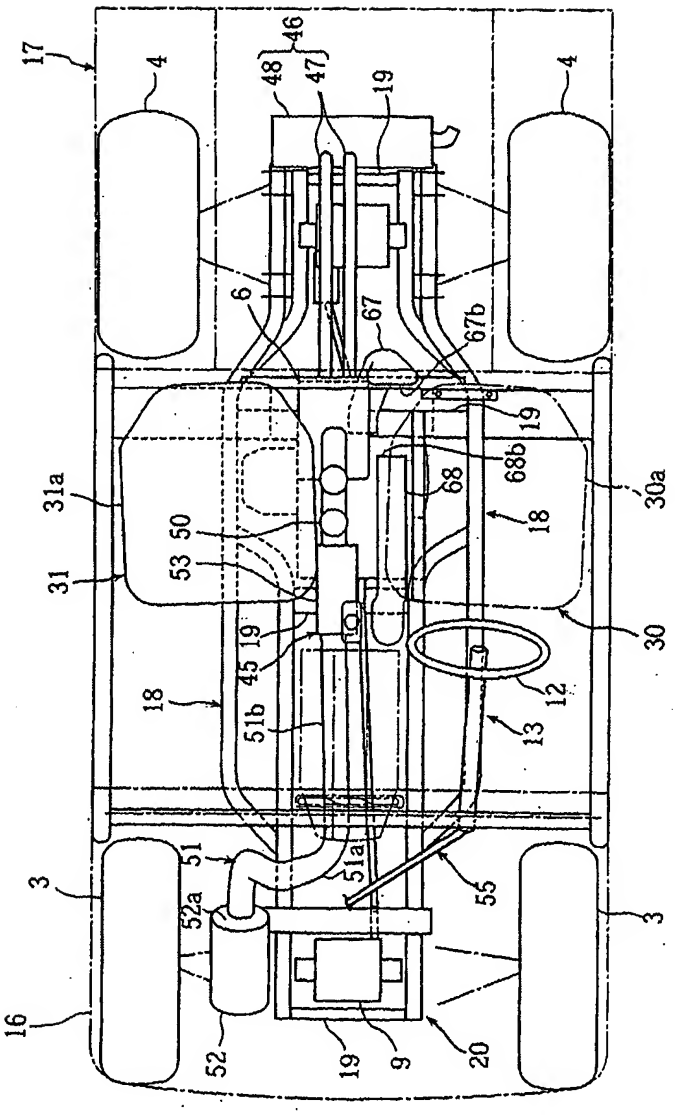


FIG. 2

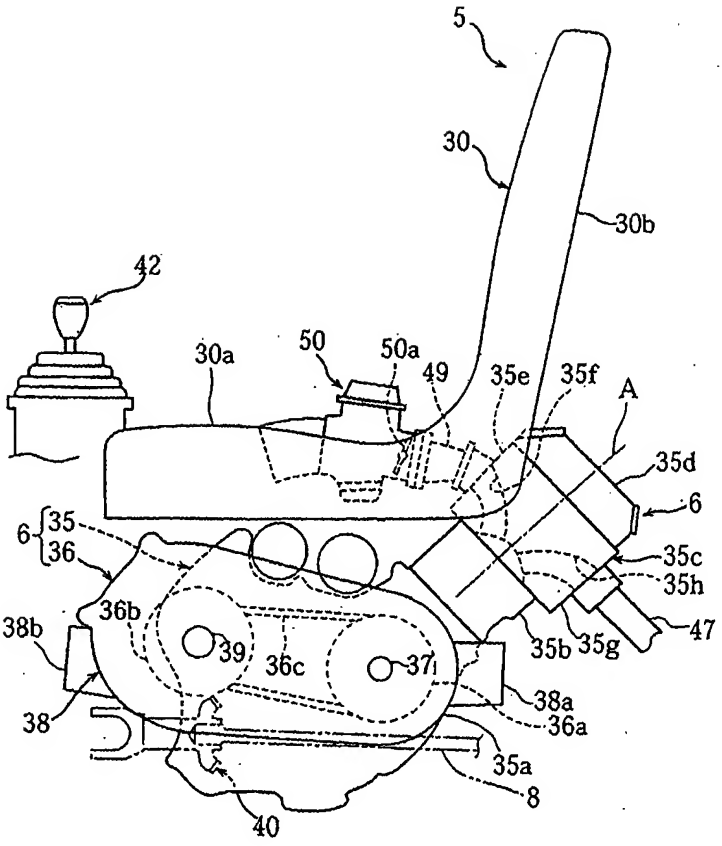


FIG. 3

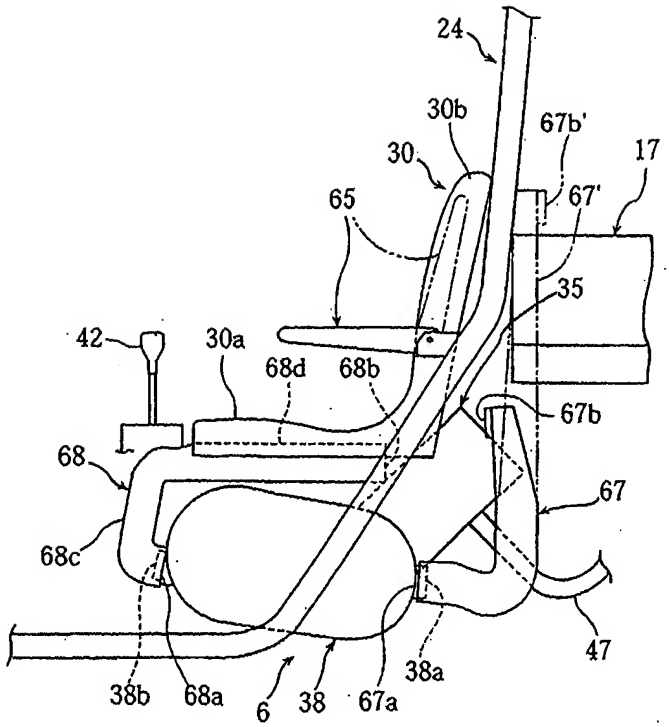


FIG. 4

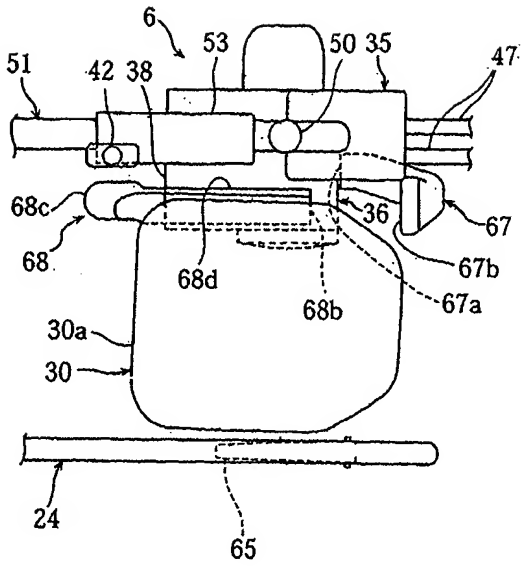
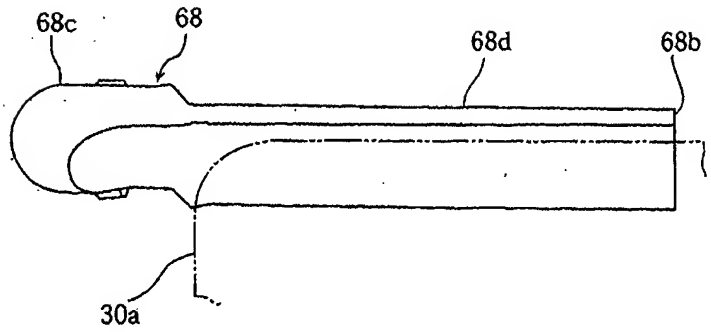


FIG. 5



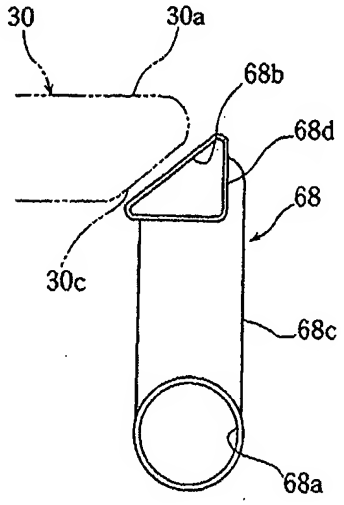
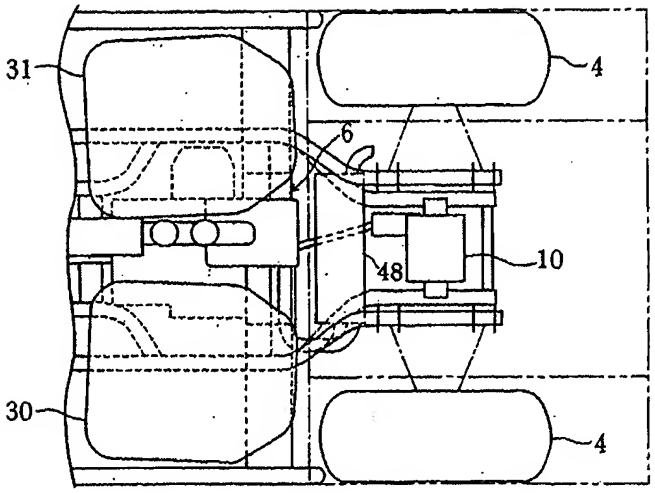


FIG. 6



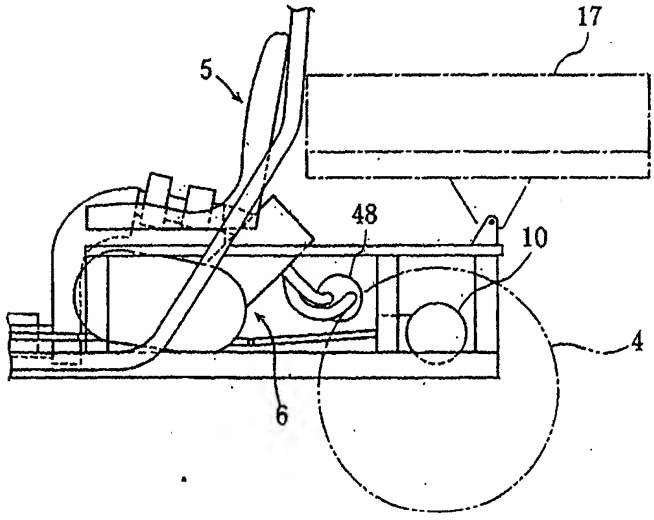


FIG. 7

[Document Name] Abstract

[Abstract]

[Problem to be Solved] To provide a power transmission device of an engine for an all terrain vehicle capable of reliably preventing ingress of water in a transmission case and effecting running at the time of restarting.

[Solution] A cooling air suction duct 67 connected to a transmission case 38 for housing a V-belt type continuously variable transmission 36, is opened at a higher place than the seat surface of a seat 5, and a cooling air delivery duct 68 near the seat surface of the seat 5.

[Selected Drawing] Fig. 4